TEACHER'S GUIDE $.30

DIGITAL EQUIPMENT CORPORATION

education

HUNTINGTON II Simulation Program—MALAR

digital

DEC EDUCATIONAL PUBLICATIONS

A partial list of the publications in the continuing series of curriculum material published by DEC for use with EduSystems and RSTS are listed below. Please inquire directly for prices on classroom quantities.

Additional publications may be obtained from:

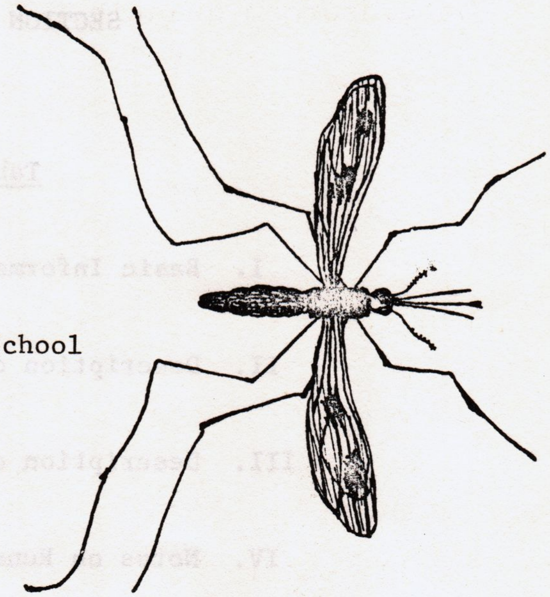
Software Distribution Center
Digital Equipment Corporation
Maynard, Massachusetts 01754

Populution: Self-teaching BASIC Workbook	$2.00
BASIC Matrix Operations	$1.00
Computer-Augmented Calculus Topics	$1.50
Problems For Computer Mathematics	$1.25
Advanced Problems For Computer Mathematics	$2.00
BASIC Application Programs	
Mathematics I	$1.00
Mathematics II	1.00
Science	1.00
Business and Social Studies	1.00
Plotting	1.00
Huntington I Application Programs	
MATHEMATICS	$2.00
TEACHER ASSISTANCE	1.00
Huntington I Simulation Programs	
BIOLOGY	$1.00
CHEMISTRY	2.00
EARTH SCIENCE	1.00
PHYSICS	2.00
SOCIAL STUDIES	1.00
Huntington II Simulation Modules	
Student Workbook	$0.30
Teacher's Guide	.30
Resource Handbook	.50
Program Paper Tape	1.00

TEACHER MANUAL

MALARIA ERADICATION PROGRAM

MALAR



Developed By:

James Friedland
General Douglas MacArthur High School
Levittown, New York
Austin Frishman
State University of New York
Farmingdale, New York

Support Material By:

Elizabeth A. Williamson
Northwest Regional Educational Laboratories
Portland, Oregon

Programmed By:

James Friedland
Stuart Hollander
State University of New York
Stony Brook, New York

HUNTINGTON TWO COMPUTER PROJECT

Copyright © 1973, State University of New York

1 March 1973

The work of the Huntington Two Computer Project is partially supported by the National Science Foundation, Grant GW-5883.

MALAR

SECTION II - TEACHER MANUAL

Table of Contents

I. Basic Information about the Unit 1

II. Description of the Unit 2

III. Description of the Program 2

IV. Notes on Running the Program 4

V. Sample Run 5

VI. Rationale for the Unit 7

VII. Suggested Objectives for the Unit 7

VIII. Plan for Using the Unit 9

IX. Teacher Introduction to the *STUDENT MANUAL* 11

MALAR

TEACHER MANUAL

I. BASIC INFORMATION ABOUT THE UNIT

Subject Area: Biology, social studies, health, ecology

Specific Topic: Malaria and its eradication

Grade Level: 10 - 12

Coordinated Computer Programs: MALAR

Computer Language: BASIC

Special Language Features Used: RANDOMIZE, FNR

Abstract: A computer program which allows the user to attempt to control a malaria epidemic provides a context within which to study the biological, economic, social, political, and ecological aspects of a classic world health problem.

NOTE: FOR THOSE USING SMALLER COMPUTERS: START MALAR PAPER TAPE IN MIDDLE AFTER THE SECOND LEADER. PROGRAM SHOULD START AT 400 IF PROPERLY LOADED. YOU WILL BE MISSING INITIAL POPULATION DATA AND TREATMENT COST DATA SHOWN ON PAGE 3.

II. DESCRIPTION OF THE UNIT

This unit focuses on malaria eradication as a classic example of a world health problem. Although the materials in the unit consider the biological and medical aspects of the problem, they by no means stop there. The problem is put into economic, social, political, and ecological perspectives, and is treated as a representative case study of a health problem which involves a multiplicity of concerns for its solution.

The *TEACHER MANUAL* describes general strategies for successful use of the computer program, details a plan for use of the unit, and suggests several contexts in which it might be introduced. The *STUDENT MANUAL* provides a clear description of the computer program, and gives exploration exercises for use with the computer program. These exercises guide the student in exploring cost, effectiveness, and strategy with respect to a malaria eradication program. In addition, the *STUDENT MANUAL* helps the students learn to deal with contingency factors and to display and interpret their results in graphic form. The *RESOURCE MANUAL* includes an extensive section of background information about malaria and many related topics. It also treats health in general as an economic, ecologic, social, and political concern. The *RESOURCE MANUAL* includes a list of projects, an annotated bibliography of resources, and a complete description of the mathematical model used in the program.

III. DESCRIPTION OF THE PROGRAM

The program MALAR simulates the attack phase of a malaria eradication plan. It allows the user to attempt to eradicate malaria from a given area within five years. The user can try to do this with or without a budget limitation.

Be sure that the student knows he is working with the following conditions.

APPROX. POPULATION OF AREA: 100000

APPROX. NUMBER ILL WITH MALARIA: 25000

APPROX. NUMBER DEATHS/YEAR DUE TO MALARIA: 1000

GOAL: ERADICATE OR MINIMIZE THE MALARIA INCIDENCE IN THE AREA OVER A 5-YEAR PERIOD.

THE USER CAN MAKE USE OF A 4-TREATMENT METHOD, NAMELY:

1) To isolate in field hospitals those afflicted by malaria

2) To administer drugs to those who are ill

3) To use a pesticide to kill mosquitoes

4) To give preventive drugs to those still healthy

THESE ARE THE APPROXIMATE COSTS:

Field hospital of 20 beds: $2000 per year

Maximum malaria drug treatment: $2/year/person

Full anti-mosquito spray:

When using *DDT* - $ 75000
When using *Malathion* - $231000
When using *Propoxur* - $637500

Preventive drug effective 1 year: 72¢/person/year

(IF USING A BUDGET, YOU HAVE $500,000 TO WORK WITH.)

Each alternative treatment is offered, and then the user is allowed to specify the extent to which he wants to use each treatment method during the five-year period. After the user enters his decisions for a specific treatment method, the computer will print out the cost of that plan and the total amount of money allocated by the user to that point. If the program is being used with a budget restriction, the computer will print out the balance remaining in the budget. After the user has entered his decisions for all four types of treatment, the computer will tabulate the results of the user's five-year overall plan. It will specify for each year the number sick with malaria and the number of deaths caused by malaria. It will also print out the total amount spent over the five years, and if a budget restriction has been used, it will print the remaining balance. The user may then: 1) get an evaluation of the effectiveness of each part of his plan, and 2) continue with the problem for another five years, or 3) start over, or 4) stop the program.

To be considered successful, the user should reduce the total number of sick to below 1000 for a total of five consecutive years.

IV. NOTES ON RUNNING THE PROGRAM

The MALAR program is straightforward and simple to use. However, to prevent even slight confusion from arising, the following points should be mentioned.

1) When the user has finished entering all his decisions, the computer will print out a table that will show the results of his five-year plan. The first line in the table is printed with a "0" in the column headed "year." This simply refers to the time before the user began to implement his eradication plan. The other statistics in that line give the specific numbers of sick and dead at the time that the eradication plan was begun.

2) When the computer prints out the results of the five-year plan, the number of sick specified for any one year refers to the number sick during that year. The number of deaths printed refers to the actual number of deaths which occurred during that year. The number of people who actually were sick that year is usually greater than the number given in the printout, since some have usually received treatment.

In general, the best strategy to follow over a five-year period is to use both curative (hospitals and drugs for ill) measures and preventive (mosquito control and immunization) measures.

V. SAMPLE RUN

BUDGET; NO HOSPITALS: GOOD RESULTS

```
DO YOU REQUIRE INSTRUCTIONS FOR MALAR (1=YES, 0=NO) ?0
YOU MAY USE MALAR EITHER WITH A BUDGET (VERSION 1)
OR WITHOUT A BUDGET (VERSION 2). VERSION NUMBER ?1

YOUR OBJECTIVE IS TO MINIMIZE MALARIA FOR THE NEXT
5 YEARS, WITH A TOTAL FUND OF  500 THOUSAND DOLLARS

-------------------------------------------------   (HOSPITALS)

HOW MANY FIELD HOSPITALS DO YOU INTEND TO USE ?0

-------------------------------------------------   (DRUGS FOR SICK)

HOW MANY FULL TREATMENTS OF DRUGS
FOR THE ILL, SHOULD BE ORDERED PER YEAR ?7300

FOR THIS TREATMENT:
INDICATE YEARS TO BE USED BY TYPING, AFTER THE YEAR,
1=YES OR 0=NO
YEAR 1   ?1
YEAR 2   ?1
YEAR 3   ?1
YEAR 4   ?1
YEAR 5   ?1
COST OF THIS TREATMENT: $ 73000
THIS LEAVES A BALANCE OF  427000  DOLLARS

-------------------------------------------------   (MOSQUITOES)

WHAT PERCENTAGE OF MOSQUITOES DO YOU WANT TO ELIMINATE ?100
WHAT PESTICIDE WILL YOU USE
1=DDT       2=MALATHION      3=PROPOXUR
 ?1

FOR THIS TREATMENT:
YEAR 1   ?1
YEAR 2   ?1
YEAR 3   ?1
YEAR 4   ?1
YEAR 5   ?1
COST OF THIS TREATMENT: $ 375000
THIS LEAVES A BALANCE OF  52000  DOLLARS
```

```
-------------------------------------------------   (PREVENTIVE DRUGS)

HOW MANY DOSES OF PREVENTIVE DRUGS, FOR THOSE
HEALTHY, DO YOU WANT TO ORDER PER YEAR ?10000

FOR THIS TREATMENT:
YEAR 1  ?1
YEAR 2  ?1
YEAR 3  ?1
YEAR 4  ?1
YEAR 5  ?1
COST OF THIS TREATMENT: $ 36000
THIS LEAVES A BALANCE OF  16000  DOLLARS

USING YOUR PLAN:
YEAR          NO. SICK      NO. DEATHS DUE TO MALARIA
----          --------      -------------------------
 0             24881         939
 1             692           3
 2             706           7
 3             707           7
 4             698           5
 5             703           6

OVER YOUR  5  YEAR TREATMENT PROGRAM
 28  DEATHS DUE TO MALARIA HAVE BEEN RECORDED

DO YOU WISH AN EVALUATION (1=YES, 0=NO) ?1


TOTAL COST  484000  DOLLARS
PROGRAM       COST          YEARS         EFFECTIVENESS (PCT.)
-------       ----          -----         --------------------
DRUG TREAT     73000         5             85
MOSQ SPRAY     375000        5             80
PREVENT DRUG   36000         5             6

SURPLUS ORDERING:
 13124  TREATMENTS OF DRUGS FOR SICK UNUSED
OF THESE  5997  DOSES ARE STILL USABLE

DO YOU WANT TO (1) TAKE THE NEXT FIVE YEARS
OR (2) START OVER  OR (3) END. TYPE NUMBER ?3


TIME:  2.93 SECS.

READY
```

VI. RATIONALE FOR THE UNIT

The MALAR unit provides a context within which to explore the economic, biological, political, and ecological ramifications of a classic example of a serious health problem. Often the problems of public health are viewed only as medical ones, when in fact they are also very much economic, political, and even ecological. A unit of study such as that suggested by MALAR can be of great assistance in helping students learn about, and gain an appreciation of these other factors related to health problems.

Many school programs are beginning to recognize the importance of the study of health at all levels and in the broad sense of the term. A unit like MALAR provides a novel, interesting core for a related unit of study. Since MALAR treats a classic health problem, it provides a springboard to considerations of other health problems.

At a more specific level, MALAR helps a student to learn something about epidemiology and the health problem of malaria. He can determine basic principles of dealing with an epidemic disease. The computer program allows the student to become the decision-maker in a situation involving public health, and requires him to balance economic considerations with biological and medical ones. Using the computer simulation, the student has an opportunity to explore a public health situation from new perspectives and at the same time to develop some important inquiry and problem-solving skills.

VII. SUGGESTED OBJECTIVES FOR THE UNIT

General Objectives

A. To convey a sense of the complexity of a health problem by allowing the student to explore economic, ecologic and other concerns as well as medical and biological factors.

B. To help students gain a sense of the various strategies which can be used to fight an epidemic and the relative costs and effectiveness of these strategies.

C. To provide students with some exposure to the areas of public health and epidemiology.

D. To allow the student to explore the consequences of banning DDT in malaria-control programs worldwide.

Specific Objectives

After completing this exercise, a student should be able to:

A. Briefly discuss the disease of malaria, including points such as:

  1) how it is transmitted
  2) the types of conditions under which it will appear
  3) strategies for eradicating it
  4) the status of the disease in the world today

B. Based on his experience with the MALAR computer program, discuss the effect of each of the following types of treatment programs on the disease epidemic:

  1) field hospitals
  2) drug treatments for the ill
  3) mosquito control using pesticides
  4) preventive medicine

C. Based on his experience with the MALAR computer program, discuss the most effective strategy he found for eradicating the disease when a) he had no financial restriction, and b) he had a financial restriction.

D. Discuss the four stages of a disease-eradication program:

  1) preparatory phase
  2) attack phase
  3) consolidation phase
  4) maintenance phase

  Briefly describe the activities which are carried out during each phase.

E. Discuss some political, social, economic, and ecologic concerns related to health.

F. Briefly summarize the major arguments on both sides of the controversy over DDT.

VIII. PLAN FOR USING THE UNIT

A. Curricular Openings for This Exercise

The MALAR unit could be introduced at several different points in several different curriculum areas. In biology, the unit makes a nice accompaniment to Chapter 1 in the BSCS Yellow version, in which malaria is studied as an example of a biological problem. It would also be appropriate in biology when studies focus on ecology or epidemic diseases.

MALAR could also be integrated into a social studies unit which focuses upon health as a condition for social and economic growth, or upon the economic aspects of health maintenance. A study of ecological problems also provides an ideal setting for the use of MALAR, because it allows the student to explore the use of various pesticides in a critical emergency situation.

In addition, MALAR would fit in nicely at many points in a health curriculum. It would enhance any study of world health problems, or the study of health as a part of a total environmental system.

MALAR is also a good computer simulation which could serve as an introduction to modeling and simulation.

B. Preparatory Activities

Prior to actually using the MALAR program, the students should acquire some background information about such topics as health, epidemic control, malaria, and pesticides. The *RESOURCE MANUAL* included with this unit comprises a section of background material which should be sufficient. It is written for the suudent and could be given directly to him for use as a text, or it could be used by the teacher to prepare several class sessions which would deal with the topics involved. Of course, there are many different ways to approach this preliminary activity. Students could be given research assignments on the various topics and the information presented at a class "symposium." In any case, this section of the *RESOURCE MANUAL* does provide some idea of the kinds of information that are important for a student to have in order to approach the MALAR program with some base of knowledge.

In addition, the students should fully understand that they are using a simulation which was designed under a specific set of assumptions. They should know what those assumptions are and should have an opportunity to discuss them. Also, the students should understand how MALAR works, what they will be expected to do with the program, and what the program will do for them.

C. Using the Program

Students can use the MALAR program individually or in groups. The *STUDENT MANUAL* suggests several investigations which students can make using MALAR. These relate to the effectiveness of various eradication strategies, the financial considerations of health maintenance, and contingent problems. General approaches to the exercises in the *STUDENT MANUAL* are discussed under "TEACHER INTRODUCTION TO THE *STUDENT MANUAL*."

D. Follow-up Questions

Once the students have worked with the MALAR program, you may want to spend one or two class sessions discussing results. In addition to discussing the questions in the *STUDENT MANUAL*, it might be useful to explore the ideas suggested by the following questions.

1) What malaria eradication strategies did you find to be most successful?

2) Even though you might employ a prevention strategy in full strength, the actual effectiveness of that treatment option was always lower than 100%. Can you think of some reasons why the actual effectiveness would be less than 100% for each of the following:

    hospital bed program ?

    curative drug program ?

    mosquito control program ?

    immunization program ?

3) What are some economic concerns involved in solving world health problems? political concerns? social concerns? ecological concerns?

4) In your opinion, how realistic do you think the results were that you got using this simulation?

5) Who do you think should assume the costs of eradicating malaria or any other epidemic disease on a worldwide basis?

6) Who should decide whether an eradication program should be implemented in a country?

7) What happens if you cut back on precautionary measures before the epidemic is completely quelled?

8) In a malaria eradication program, if you are restricted financially so that you can only order enough preventive drug doses for half the population, how would you decide who would get the drug and who would not?

9) What kinds of information would you need to obtain during the preparatory phase of an eradication program if you were a public health official?

IX. TEACHER INTRODUCTION TO THE *STUDENT MANUAL*

The *STUDENT MANUAL* in this unit is designed as a guide for using the MALAR program. It systematically poses questions which involve the student in determining the effectiveness of various treatment options, the relative costs of the options, and some strategies that will successfully eradicate the epidemic. It also construes some contingency situations for the student to impose on the playing of the game which make winning the game a more difficult task. The exercises are not very rigidly constructed; rather they present thought-provoking questions to the student which require him to devise his own approaches to finding answers. However, they are intended to help the student organize his work with the program so that he is consciously doing more than merely making several random plays of the game. Taken as a whole, the questions suggested ensure that the student will consider relevant, important ideas while he is using the program.

REASON FOR USING THE *PLAN OF ACTION* CHART

The *PLAN OF ACTION* chart allows the student to think ahead and plan his overall control program. If the student selects to work within a budget when trying to combat malaria, he must stay within the limits of that budget. The *PLAN OF ACTION* chart permits him to see if his control program will fit within budget limits. If he overspends, he can make the necessary adjustments before going to the machine. Use of the chart helps maximize the efficiency of use time of the machine and the student. As a further check, if the student miscalculates and spends more than he should, the computer will tell him so. Three additional *PLAN OF ACTION* charts are included at the back of the *STUDENT MANUAL*.

PLAN OF ACTION

A	B	C	D	E
TREATMENT PROGRAM________	COST PER UNIT	NUMBER UNITS or PERCENT EFFICIENCY	TOTAL YEARS IN EFFECT	TOTAL COST
FIELD HOSPITALS________	2000	X_____hospitals/year	X_____years	= $________
DRUGS FOR SICK________	2	X_____doses/year	X_____years	= $________
MOSQUITOES Pesticides (choose one): a) DDT________ b) Malathion________ c) Propoxur________	 750 2310 6375	 X_____% mosquitoes killed	 X_____years	 = $________
PREVENTIVE DRUGS________	0.72	X_____doses/year	X_____years	= $________

(Amount allowed = $500,000 if following budget)

Grand Total = $________